

TENT COOPERATION TREA

From the RECEIVING OFFICE

To:

GAM, Dong Hoon

Rm No. 207, New Seoul Bldg., 828-8, Yeoksam-dong,
Kangnam-gu, Seoul 135-080, Republic of KOREA

3/5: 99. 2. 20

PCT

NOTIFICATION OF THE INTERNATIONAL APPLICATION NUMBER AND OF THE INTERNATIONAL FILING DATE

(PCT Rule 20.5(C))

Date of mailing
(day/month/year) 12 FEBURUARY 1999 (12.02.1999)

Applicant's or agent's file reference

PIS115/PCT

IMPORTANT NOTIFICATION

International application No.

PCT/KR99/00069

International filing date (day/month/year)

09 FEBURUARY 1999 (09.02.1999)

Priority date (day/month/year)

11 FEBURUARY 1998 (11.02.1998)

Applicant

I. S. MOTOR KOREA CO., LTD. et al

Title of the invention

CONSTANT-POWER BRUSHLESS DC MOTOR

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.

2. The applicant is further notified that the record copy of the international application:

☐ was transmitted to the International Bureau on _____

☒ has not yet been transmitted to the International Bureau for the reason indicated below and a copy of this notification has been sent to the International Bureau*:

☒ because the necessary national security clearance has not yet been obtained.

☐ because (reason to be specified):

* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

Name and mailing address of the receiving Office

Korean Industrial Property Office
Government Complex-Taejon, Dunsan-dong, So-ku, Taejon
Metropolitan City 302-701, Republic of Korea

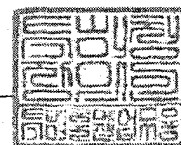
Authorized officer

COMMISSIONER

Facimile No. 82-42-472-3466

Telephone No. 82-42-481-5213

Form PCT/RO/105 (July 1992)



PATENT COOPERATION TRL

PCT

NOTIFICATION OF RECEIPT OF
RECORD COPY

(PCT Rule 24.2(a))

RECEIVED

From the INTERNATIONAL BUREAU

To:

GAM, Dong, Hoon
Gam Dong Hoon Int'L Patent & Law
Office
No.207, New Seoul Building
828-8, Yeoksam-dong
Kangnam-gu
Seoul 135-080
RÉPUBLIQUE DE CORÉE

Date of mailing (day/month/year) 26 February 1999 (26.02.99)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference PIS115/PCT	International application No. PCT/KR99/00069

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

I.S. MOTOR KOREA CO., LTD. (for all designated States except US)
LEE, I., Soo (for US)

International filing date : 09 February 1999 (09.02.99)
Priority date(s) claimed : 11 February 1998 (11.02.98)
Date of receipt of the record copy
by the International Bureau : 17 February 1999 (17.02.99)
List of designated Offices :

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE
National : AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM,
HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL,
PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW

ATTENTION

The applicant should carefully check the data appearing in this Notification. In case of any discrepancy between these data and the indications in the international application, the applicant should immediately inform the International Bureau.

In addition, the applicant's attention is drawn to the information contained in the Annex, relating to:

- ☒ time limits for entry into the national phase
☒ confirmation of precautionary designations
☐ requirements regarding priority documents

A copy of this Notification is being sent to the receiving Office and to the International Searching Authority.

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No. (41-22) 740.14.35</p>	<p>Authorized officer:</p> <p>Ting Zhao</p> <p>Telephone No. (41-22) 338.83.38</p>
---	--

PATENT COOPERATION TR.

PCT

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

GAM, Dong, Hoon
Gam Dong Hoon Int'l Patent & Law
Office
No.207, New Seoul Building
828-8, Yeoksam-dong
Kangnam-gu
Seoul 135-080
RÉPUBLIQUE DE CORÉE

RECEIVED

Date of mailing (day/month/year) 26 February 1999 (26.02.99)	
Applicant's or agent's file reference PIS115/PCT	IMPORTANT NOTIFICATION
International application No. PCT/KR99/00069	International filing date (day/month/year) 09 February 1999 (09.02.99)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 11 February 1998 (11.02.98)
Applicant I.S. MOTOR KOREA CO., LTD. et al	

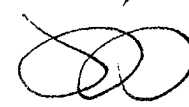
1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
3. An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.**
4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.**

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
11 Febr 1998 (11.02.98)	1998/3917	KR	17 Febr 1999 (17.02.99)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

Ting Zhao



Facsimile No. (41-22) 740.14.35

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
 United States Patent and Trademark
 Office
 Box PCT
 Washington, D.C.20231
 ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 23 August 1999 (23.08.99)	
International application No. PCT/KR99/00069	Applicant's or agent's file reference PIS115/PCT
International filing date (day/month/year) 09 February 1999 (09.02.99)	Priority date (day/month/year) 11 February 1998 (11.02.98)
Applicant LEE, I., Soo	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

02 August 1999 (02.08.99)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer S. Mafla Telephone No.: (41-22) 338.83.38
--	--

The demand must be filed directly with the competent International Preliminary Examining Authority, or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ _____

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:

The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA		Date of receipt of DEMAND
Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION		Applicant's or agent's file reference PIS115/PCT
International application No. PCT/KR99/00069	International filing date (day/month/year) 9 FEB. 1999(09.02.99)	(Earliest) Priority date (day/month/year) 11 FEB. 1998(11.02.98)
Title of invention CONSTANT-POWER BRUSHLESS DC MOTOR		
Box No. II APPLICANT(S)		
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) I.S.MOTOR KOREA CO., LTD. 7-326 INCHON INDUSTRIAL GOODS CENTER, 129, SONGHYUN-DONG, TONG-GU, INCHON, 401-040, REPUBLIC OF KOREA		Telephone No.: (82)-(032)-589-7090 Facsimile No.: (82)-(032)-589-7093 Teleprinter No.:
State (that is, country) of nationality: KR	State (that is, country) of residence: KR	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) LEE, I SOO 123 KOKAN-RI, JINJUN-MYUN, HAPO-GU, MASAN-DITY, KYUNGSANGNAM-DO, 631-830, REPUBLIC OF KOREA		
State (that is, country) of nationality: KR	State (that is, country) of residence: KR	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)		
State (that is, country) of nationality:	State (that is, country) of residence:	
<input type="checkbox"/> Further applicants are indicated on a continuation sheet.		

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following person is ☒ agent ☐ common representativeand ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

GAM, DONG HOON

GAM DONG HOON INT'L PATENT & LAW OFFICE
NO.201, NEW SEOUL BLDG., 828-8, YEOKSAM-DONG,
KANGNAM-GU, SEOUL, 135-080,
REPUBLIC OF KOREA

Telephone No.:

(82)-(02)-554-9001

Facsimile No.:

(82)-(02)-557-9004

Teleprinter No.:

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments:*

1. The applicant wishes the international preliminary examination to start on the basis of:

☐ the international application as originally filed

the description

☐ as originally filed☐ as amended under Article 34

the claims

☐ as originally filed☐ as amended under Article 19 (together with any accompanying statement)☐ as amended under Article 34

the drawings

☐ as originally filed☐ as amended under Article 342. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.3. ☐ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: ENGLISH

☒ which is the language in which the international application was filed.☐ which is the language of a translation furnished for the purposes of international search.☐ which is the language of publication of the international application.☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

- | | | |
|--|---|--------|
| 1. translation of international application | : | sheets |
| 2. amendments under Article 34 | : | sheets |
| 3. copy (or, where required, translation) of amendments under Article 19 | : | sheets |
| 4. copy (or, where required, translation) of statement under Article 19 | : | sheets |
| 5. letter | : | sheets |
| 6. other (specify) | : | sheets |

For International Preliminary Examining Authority use only

received not received

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

The demand is also accompanied by the item(s) marked below:

- | | |
|---|---|
| 1. <input checked="" type="checkbox"/> fee calculation sheet | 4. <input type="checkbox"/> statement explaining lack of signature |
| 2. <input type="checkbox"/> separate signed power of attorney | 5. <input type="checkbox"/> nucleotide and or amino acid sequence listing in computer readable form |
| 3. <input checked="" type="checkbox"/> copy of general power of attorney; reference number, if any: | 6. <input type="checkbox"/> other (specify): |

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the persons signing and the capacity in which the persons signs (if such capacity is not obvious from reading the demand).

GAM, DONG HOON



For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply.

☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

PCT

FEE CALCULATION SHEET

Annex to the Demand for international preliminary examination

International application No. PCT/KR99/00069	For International Preliminary Examining Authority use only
Applicant's or agent's file reference PIS115/PCT	Date stamp of the IPEA
Applicant I.S.MOTOR KOREA CO.,LTD., ET AL	
Calculation of prescribed fees <div style="display: flex; justify-content: space-between; align-items: flex-end;"> <div style="width: 45%;"> 1. Preliminary examination fee </div> <div style="width: 45%; text-align: right;"> <div style="border: 1px solid black; padding: 2px;">ATS 2,200.00</div> <div style="border: 1px solid black; width: 20px; text-align: center; float: right;">P</div> </div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-end; margin-top: 20px;"> <div style="width: 45%;"> 2. Handling fee <i>(Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.)</i> </div> <div style="width: 45%; text-align: right;"> <div style="border: 1px solid black; padding: 2px;">ATS 1,902.00</div> <div style="border: 1px solid black; width: 20px; text-align: center; float: right;">H</div> </div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-end; margin-top: 20px;"> <div style="width: 45%;"> 3. Total of prescribed fees Add the amounts entered at P and H and enter total in the TOTAL box </div> <div style="width: 45%; text-align: right;"> <div style="border: 1px solid black; padding: 2px;">ATS 4,102.00</div> <div style="border: 1px solid black; width: 100px; text-align: center; margin-top: 5px;">TOTAL</div> </div> </div>	
Mode of Payment <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <input type="checkbox"/> authorization to charge deposit account with the IPEA (see below) </div> <div style="width: 45%;"> <input checked="" type="checkbox"/> cash </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="width: 45%;"> <input type="checkbox"/> cheque </div> <div style="width: 45%;"> <input type="checkbox"/> revenue stamps </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="width: 45%;"> <input type="checkbox"/> postal money order </div> <div style="width: 45%;"> <input type="checkbox"/> coupons </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="width: 45%;"> <input type="checkbox"/> bank draft </div> <div style="width: 45%;"> <input type="checkbox"/> other (specify): </div> </div>	
Deposit Account Authorization <i>(this mode of payment may not be available at all IPEAs)</i> The IPEA/ _____ <input type="checkbox"/> is hereby authorized to charge the total fees indicated above to my deposit account. <div style="display: flex; align-items: center;"> <input type="checkbox"/> <div style="margin-left: 10px;"> <i>(this check-box may be marked only if the conditions for deposit accounts of the IPEA so permit)</i> is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account. </div> </div>	
Deposit Account Number _____	Date (day/month/year) _____
Signature _____	



PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:

GAM, DONG HOON
GAM DONG HOON INT'L PATENT & LAW
OFFICE
NO.207, NEW SEOUL BLDG., 828-8
YEOKSAM-DONG, KANGNAM-GU
SEOUL 135-080
REPUBLIC OF KOREA

RECEIVED

Aug. 23, 1999

NOTIFICATION OF RECEIPT OF DEMAND BY COMPETENT INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

(PCT Rules 59.3(e) and 61.1(b), first sentence
and Administrative Instructions, Section 601(a))

Date of mailing
(day/month/year) 17 Aug. 1999 (17.08.99)

Applicant's or agent's file reference
PIS115/PCT

IMPORTANT NOTIFICATION

International application No.
PCT / KR 99/00069

International filing date (day/month/year)
9 Feb. 1999 (09.02.99)

Priority date (day/month/year)
11 Feb. 1998 (11.02.98)

Applicant

I. S. MOTOR KOREA CO., LTD. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:
2 Aug. 1999 (02.08.99)

2. That date of receipt is:

- ☒ the actual date of receipt of the demand by this Authority (Rule 61.1(b)).
- ☐ the actual date of receipt of the demand on behalf of this Authority (Rule 59.3(e)).
- ☐ the date on which this Authority has, in response to the invitation to correct defects in the demand (Form PCT/IPEA/404), received the required corrections.

3. ☐ **ATTENTION:** That date of receipt is **AFTER** the expiration of 19 months from the priority date. Consequently, the election(s) made in the demand does (do) not have the effect of postponing the entry into the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22). For details, see the *PCT Applicant's Guide*, Volume II.

- ☐ (If applicable) This notification confirms the information given by telephone, facsimile transmission or in person on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Attention: The amount of the handling fee was changed on 02 March 1999
to ATS 2.036,52.

Name and mailing address of the IPEA/ AT
AUSTRIAN PATENT OFFICE
Kohlmarkt 8-10
A-1014 Vienna
Facsimile No. +43 / 1 / 534 24 - 200

Authorized officer
Koch
+43 / 1 / 534 24 - 450
Telephone No.

PATENT COOPERATION TREATY

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

GAM, Dong, Hoon
Gam Dong Hoon Int'l Patent & Law
Office
No.207, New Seoul Building
828-8, Yeoksam-dong
Kangnam-gu
Seoul 135-080
RÉPUBLIQUE DE CORÉE

RECEIVED

Aug. 30, 1999

Date of mailing (day/month/year) 19 August 1999 (19.08.99)		
Applicant's or agent's file reference PIS115/PCT		IMPORTANT NOTICE
International application No. PCT/KR99/00069	International filing date (day/month/year) 09 February 1999 (09.02.99)	Priority date (day/month/year) 11 February 1998 (11.02.98)
Applicant I.S. MOTOR KOREA CO., LTD. et al		

- Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AU,CN,EP,IL,JP,KP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

- The following designated Offices have waived the requirement for such a communication at this time:

AL,AM,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EE,ES,FI,GB,GE,GH,GM,HR,HU,ID,IS,KE,
KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,
TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

- Enclosed with this Notice is a copy of the international application as published by the International Bureau on
19 August 1999 (19.08.99) under No. WO 99/41829

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer J. Zahra Telephone No. (41-22) 338.83.38
--	---

INTERNATIONAL COOPERATION TREATY

PCT

INFORMATION CONCERNING ELECTED
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

From the INTERNATIONAL BUREAU

To:

GAM, Dong, Hoon
Gam Dong Hoon Int'l Patent & Law
Office
No.207, New Seoul Building
828-8, Yeoksam-dong
Kangnam-gu
Seoul 135-080
RÉPUBLIQUE DE CORÉE

RECEIVED

Sep. 2, 1999

Date of mailing (day/month/year) 23 August 1999 (23.08.99)		
Applicant's or agent's file reference PIS115/PCT		IMPORTANT INFORMATION
International application No. PCT/KR99/00069	International filing date (day/month/year) 09 February 1999 (09.02.99)	
		Priority date (day/month/year) 11 February 1998 (11.02.98)
Applicant I.S. MOTOR KOREA CO., LTD. et al		

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

EP : AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE

National : AU, BG, BR, CA, CN, CZ, DE, GB, IL, JP, KP, KR, MN, NO, NZ, PL, RO, RU, SE, SK, US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

National : AL, AM, AT, AZ, BA, BB, BY, CH, CU, DK, EE, ES, FI, GE, GH, GM, HR, HU, ID, IS, KE,
KG, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MW, MX, PT, SD, SG, SI, SL, TJ, TM, TR, TT, UA,
UG, UZ, VN, YU, ZW

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

S. Mafla

Facsimile No. (41-22) 740.14.35

Telephone No. (41-22) 338.83.38

17
REC'D 15 MAY 2000

WIPO

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PIS115/PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/KR 99/00069	International filing date (day/month/year) 09 February 1999 (09.02.99)	Priority Date (day/month/year) 11 February 1998 (11.02.98)
International Patent Classification (IPC) or national classification and IPC IPC⁷: H 02 K 29/00		
Applicant I.S. MOTOR KOREA CO., LTD et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examination Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of <u>3</u> sheets, including this cover sheet. <input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of _____ sheets.
3. This report contains indications relating to the following items: I <input type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 02 August 1999 (02.08.99)	Date of completion of this report 05 May 2000 (05.05.00)
Name and mailing address of the IPEA/AT Austrian Patent Office Kohlmarkt 8-10 A-1014 Vienna Facsimile No. 1/53424/200	Authorized officer Dimitrow Telephone No. 1/53424/340

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/KR 99/00069

I. Basis of the report

1. With regard to the elements of the international application:*

- ☒ the international application as originally filed
- ☐ the description:
 pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☐ the claims:
 pages _____, as originally filed
 pages _____, as amended (together with any statement) under Article 19
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☐ the drawings:
 pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____
- ☐ the sequence listing part of the description:
 pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item. These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as „originally filed“ and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/KR 99/00069

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-4	YES
	Claims		NO
Inventive step (IS)	Claims	2	YES
	Claims	1,3,4	NO
Industrial applicability (IA)	Claims	1-4	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The following documents were cited in the search report:

D1 US 4882524 A
D2 US 4484115 A
D3 US 5327069 A
D4 DE 2101937 A

Document D1 shows a multi-phase bipolar brushless D.C. Motor with the features of claim 1. Each phase has a plurality of windings which however are connected in series.

Document D2 shows a brushless D.C. Motor, whose armature windings are connected together at one end and connected to respective commutating devices at the other ends.

In combination of document D1 with document D2 the subject-matter of claims 1,3 and 4 is considered not to include an inventive step. The selection of the type of circuit is a matter of normal design procedure. The skilled person would regard the necessary circuits according to the measures of claim 1, 3 or 4 as a normal design possibility in order to solve the problem posed.

Documents D3 and D4 show the state of the art only.

Industrial applicability is given for all claims.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) PIS115/PCT

Box No. I TITLE OF INVENTION

CONSTANT-POWER BRUSHLESS DC MOTOR

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

I. S. MOTOR KOREA CO., LTD.

7-326 INCHON INDUSTRIAL GOODS CENTER, 129,
SONGHYUN-DONG, TONG-GU, INCHON, 401-040,
REPUBLIC OF KOREA

☐ This person is also inventor.

Telephone No.
(82)-(032)-589-7090

Facsimile No.
(82)-(032)-589-7093

Teleprinter No.

State (that is, country) of nationality: KR

State (that is, country) of residence: KR

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

LEE, I SOO

123 KOKAN-RI, JINJUN-MYUN, HAPU-GU, MASAN-CITY,
KYUNGSANGNAM-DO, 631-830, REPUBLIC OF KOREA

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality: KR

State (that is, country) of residence: KR

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)
GAM, DONG HOON

GAM DONG HOON INT'L PATENT & LAW OFFICE
NO.207, NEW SEOUL BLDG., 828-8, YEOKSAM-DONG,
KANGNAM-GU, SEOUL, 135-080, REPUBLIC OF KOREA

Telephone No.
(82)-(02)-554-9001

Facsimile No.
(82)-(02)-557-9004

Teleprinter No.

☐ Address for correspondence: Mark this checkbox where an agent or common representative has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

Regional Patent

- ☐ AP **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☐ EA **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☐ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)


National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|--|--|
| <input checked="" type="checkbox"/> AL Albania | <input checked="" type="checkbox"/> LS Lesotho |
| <input checked="" type="checkbox"/> AM Armenia | <input checked="" type="checkbox"/> LT Lithuania |
| <input checked="" type="checkbox"/> AT Austria | <input checked="" type="checkbox"/> LU Luxembourg |
| <input checked="" type="checkbox"/> AU Australia | <input checked="" type="checkbox"/> LV Latvia |
| <input checked="" type="checkbox"/> AZ Azerbaijan | <input checked="" type="checkbox"/> MD Republic of Moldova |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina | <input checked="" type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> BB Barbados | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> BG Bulgaria | <input checked="" type="checkbox"/> MN Mongolia |
| <input checked="" type="checkbox"/> BR Brazil | <input checked="" type="checkbox"/> MW Malawi |
| <input checked="" type="checkbox"/> BY Belarus | <input checked="" type="checkbox"/> MX Mexico |
| <input checked="" type="checkbox"/> CA Canada | <input checked="" type="checkbox"/> NO Norway |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein | <input checked="" type="checkbox"/> NZ New Zealand |
| <input checked="" type="checkbox"/> CN China | <input checked="" type="checkbox"/> PL Poland |
| <input checked="" type="checkbox"/> CU Cuba | <input checked="" type="checkbox"/> PT Portugal |
| <input checked="" type="checkbox"/> CZ Czech Republic | <input checked="" type="checkbox"/> RO Romania |
| <input checked="" type="checkbox"/> DE Germany | <input checked="" type="checkbox"/> RU Russian Federation |
| <input checked="" type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> SD Sudan |
| <input checked="" type="checkbox"/> EE Estonia | <input checked="" type="checkbox"/> SE Sweden |
| <input checked="" type="checkbox"/> ES Spain | <input checked="" type="checkbox"/> SG Singapore |
| <input checked="" type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> SI Slovenia |
| <input checked="" type="checkbox"/> GB United Kingdom | <input checked="" type="checkbox"/> SK Slovakia |
| <input checked="" type="checkbox"/> GE Georgia | <input checked="" type="checkbox"/> SL Sierra Leone |
| <input checked="" type="checkbox"/> GH Ghana | <input checked="" type="checkbox"/> TJ Tajikistan |
| <input checked="" type="checkbox"/> GM Gambia | <input checked="" type="checkbox"/> TM Turkmenistan |
| <input checked="" type="checkbox"/> GW Guinea-Bissau | <input checked="" type="checkbox"/> TR Turkey |
| <input checked="" type="checkbox"/> HR Croatia | <input checked="" type="checkbox"/> TT Trinidad and Tobago |
| <input checked="" type="checkbox"/> HU Hungary | <input checked="" type="checkbox"/> UA Ukraine |
| <input checked="" type="checkbox"/> ID Indonesia | <input checked="" type="checkbox"/> UG Uganda |
| <input checked="" type="checkbox"/> IL Israel | <input checked="" type="checkbox"/> US United States of America |
| <input checked="" type="checkbox"/> IS Iceland | |
| <input checked="" type="checkbox"/> JP Japan | |
| <input checked="" type="checkbox"/> KE Kenya | <input checked="" type="checkbox"/> UZ Uzbekistan |
| <input checked="" type="checkbox"/> KG Kyrgyzstan | <input checked="" type="checkbox"/> VN Viet Nam |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | <input checked="" type="checkbox"/> YU Yugoslavia |
| | <input checked="" type="checkbox"/> ZW Zimbabwe |
| <input checked="" type="checkbox"/> KR Republic of Korea | |
| <input checked="" type="checkbox"/> KZ Kazakhstan | |
| <input checked="" type="checkbox"/> LC Saint Lucia | |
| <input checked="" type="checkbox"/> LK Sri Lanka | |
| <input checked="" type="checkbox"/> LR Liberia | |

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☐
- ☐

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

Box No. VI PRIORITY CLAIM		<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 11 FEBRUARY, 1998 (11. 02. 98)	1998-3917	KR		
item (2)				
item (3)				
<input type="checkbox"/> The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s):				
<i>* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.</i>				
Box No. VII INTERNATIONAL SEARCHING AUTHORITY				
Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):		Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority): Date (day/month/year) Number Country (or regional Office)		
ISA / AT				
Box No. VIII CHECK LIST; LANGUAGE OF FILING				
This international application contains the following number of sheets: request : 3 description (excluding sequence listing part) : 13 claims : 2 abstract : 1 drawings : 10 sequence listing part of description : Total number of sheets : 29		This international application is accompanied by the item(s) marked below: 1. <input checked="" type="checkbox"/> fee calculation sheet 2. <input checked="" type="checkbox"/> separate signed power of attorney 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: 4. <input type="checkbox"/> statement explaining lack of signature 5. <input checked="" type="checkbox"/> priority document(s) identified in Box No. VI as item(s): 6. <input type="checkbox"/> translation of international application into (language): 7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material 8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form 9. <input type="checkbox"/> other (specify):		
Figure of the drawings which should accompany the abstract: 1		Language of filing of the international application: ENGLISH		
Box No. IX SIGNATURE OF APPLICANT OR AGENT				
Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).				
GAM, DONG HOON 				

For receiving Office use only	
1. Date of actual receipt of the purported international application:	2. Drawings: <input type="checkbox"/> received: <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA /	
6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.	

For International Bureau use only
Date of receipt of the record copy by the International Bureau:

PCT

FEE CALCULATION SHEET Annex to the Request

For receiving Office use only

International application No.

Applicant's or agent's
file reference

PIS115/PCT

Date stamp of the receiving Office

Applicant

I. S. MOTOR KOREA CO., LTD., ET AL

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE 45,000 T

2. SEARCH FEE 223,000 S

International search to be carried out by AUSTRIAN PATENT OFFICE
(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

The international application contains 29 sheets.

first 30 sheets 565,200 b1

_____ x _____ = _____ b2

remaining sheets additional amount

Add amounts entered at b1 and b2 and enter total at B 565,200 B

Designation Fees

The international application contains 73 designations.

10 x 130,400 = 1,304,000 D

number of designation fees payable (maximum 11) amount of designation fee

Add amounts entered at B and D and enter total at I 1,869,200 I

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

4. FEE FOR PRIORITY DOCUMENT (if applicable) P

5. TOTAL FEES PAYABLE KRW2,137,200

Add amounts entered at T, S, I and P, and enter total in the TOTAL box TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☐ authorization to charge
deposit account (see below)

☐ bank draft

☐ coupons

☐ cheque

☒ cash

☐ other (specify):

☐ postal money order

☐ revenue stamps

DEPOSIT ACCOUNT AUTHORIZATION (this mode of payment may not be available at all receiving Offices)

The RO/ _____ ☐ is hereby authorized to charge the total fees indicated above to my deposit account.

☐ is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☐ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

Deposit Account No.

Date (day/month/year)

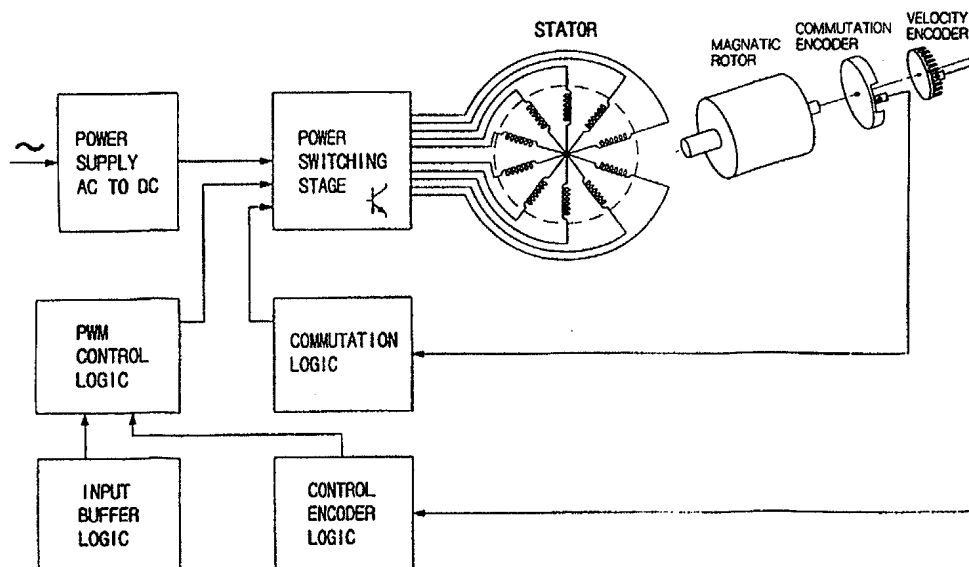
Signature



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)--

(51) International Patent Classification ⁷ : H02K 29/00	A3	(11) International Publication Number: WO 99/41829 (43) International Publication Date: 19 August 1999 (19.08.99)
<p>(21) International Application Number: PCT/KR99/00069</p> <p>(22) International Filing Date: 9 February 1999 (09.02.99)</p> <p>(30) Priority Data: 1998/3917 11 February 1998 (11.02.98) KR</p> <p>(71) Applicant (for all designated States except US): I.S. MOTOR KOREA CO., LTD. [KR/KR]; 7-326, Incheon Industrial Goods Center, 129, Songhyun-dong, Tong-gu, Incheon 401-040 (KR).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): LEE, I., Soo [KR/KR]; 123, Kokan-ri, Jinjun-Myun, Hapo-gu, Masan-city, Kyungsang-nam-do 631-830 (KR).</p> <p>(74) Agent: GAM, Dong, Hoon; Gam Dong Hoon Int'l Patent & Law Office, No.207, New Seoul Building, 828-8, Yeoksam-dong, Kangnam-gu, Seoul 135-080 (KR).</p>	<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p>Published With international search report.</p> <p>(88) Date of publication of the international search report: 3 August 2000 (03.08.00)</p>	

(54) Title: CONSTANT-POWER BRUSHLESS DC MOTOR



(57) Abstract

A constant-power brushless DC motor is provided, including a stator which is wound in parallel by phases and polarities and configured of n multi-phases, a rotor having a predetermined number of polarities, which is required to concentrate magnetic flux on its area, a commutation encoder including sensing regions and nonsensing regions, and two photo sensors set to each phase, the two photo sensors being connected to a controller, to excite only $(n-b)$ phases among n phases, starting and rotating the motor, thereby realizing a constant-power DC motor without commutator, which is effective in energy saving, has good characteristic of continuous speed conversion and compact configuration.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakistan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 99/00069

A. CLASSIFICATION OF SUBJECT MATTER

IPC⁷: H 02 K 29/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC⁷: H 02 K, H 02 P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4882524 A (LEE) 21 November 1989 (21.11.89), column 1, line 53 - column 2, line 19; claims.	1,3,4
Y	US 4484115 A (TAKAHASHI) 20 November 1984 (20.11.84), column 4, line 48 - column 5, line 37; fig. 8-10.	1,3,4
A	US 5327069 A (RADUN et al.) 05 July 1994 (05.07.94), abstract; fig. 5,8.	1
A	DE 2101937 A (TOKYO SHIBAURA) 29 July 1971 (29.07.71), claims 1,6,7; fig. 6A,7,8.	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

„A“ document defining the general state of the art which is not considered to be of particular relevance

„E“ earlier application or patent but published on or after the international filing date

„L“ document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

„O“ document referring to an oral disclosure, use, exhibition or other means

„P“ document published prior to the international filing date but later than the priority date claimed

„T“ later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

„X“ document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

„Y“ document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

„&“ document member of the same patent family

Date of the actual completion of the international search

02 May 2000 (02.05.00)

Date of mailing of the international search report

10 May 2000 (10.05.00)

Name and mailing address of the ISA/AT
Austrian Patent Office
Kohlmarkt 8-10; A-1014 Vienna
Facsimile No. 1/53424/200

Authorized officer

Dimitrow

Telephone No. 1/53424/340

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR 99/00069

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
US	A	4882524	21-11-1989	AU	A1	14472/88	27-10-1988
				AU	B2	616365	24-10-1991
				BE	AD	1004032	15-09-1992
				CH	A	682193	30-07-1993
				DE	A1	3812638	10-11-1988
				DE	C2	3812638	14-06-1995
				ES	AF	2007816	01-07-1989
				FR	A1	2614480	28-10-1988
				GB	A0	8808555	11-05-1988
				GB	A1	2204197	02-11-1988
				GB	B2	2204197	08-05-1991
				HK	A	832/92	06-11-1992
				IT	A0	8847880	21-04-1988
				IT	A	1219549	18-05-1990
				KR	B1	8904099	20-10-1989
				SG	A	432/92	12-06-1992
US	A	4484115	20-11-1984	JP	A2	58012566	24-01-1983
US	A	5327069	05-07-1994			none	
DE	B2	2101937	22-09-1977	GB	A	1293291	18-10-1972
DE	C3	2101937	18-05-1978	JP	B4	51028128	17-08-1976
DE	A	2101937	29-07-1971	JP	B4	51028127	17-08-1976
				JP	B4	49041962	12-11-1974
				JP	B4	52018363	21-05-1977

(51) International Patent Classification ⁶ : H02P		A2	(11) International Publication Number: WO 99/41829
			(43) International Publication Date: 19 August 1999 (19.08.99)
(21) International Application Number: PCT/KR99/00069		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).	
(22) International Filing Date: 9 February 1999 (09.02.99)			
(30) Priority Data: 1998/3917 11 February 1998 (11.02.98) KR			
(71) Applicant (for all designated States except US): I.S. MOTOR KOREA CO., LTD. [KR/KR]; 7-326, Incheon Industrial Goods Center, 129, Songhyun-dong, Tong-gu, Incheon 401-040 (KR).		Published Without international search report and to be republished upon receipt of that report.	
(72) Inventor; and (75) Inventor/Applicant (for US only): LEE, I., Soo [KR/KR]; 123, Kokan-ri, Jinjun-Myun, Hapo-gu, Masan-city, Kyungsang-nam-do 631-830 (KR).			
(74) Agent: GAM, Dong, Hoon; Gam Dong Hoon Int'l Patent & Law Office, No.207, New Seoul Building, 828-8, Yeoksam-dong, Kangnam-gu, Seoul 135-080 (KR).			

The diagram illustrates a closed-loop speed control system for a brushless motor. The components and their interconnections are as follows:

- POWER SUPPLY AC TO DC:** Receives AC input (indicated by a sine wave symbol) and provides DC power to the POWER SWITCHING STAGE.
- POWER SWITCHING STAGE:** Receives DC power from the AC-to-DC converter and PWM signals from the PWM CONTROL LOGIC. It drives the STATOR.
- STATOR:** The main power stage of the motor, shown as a circular assembly with multiple windings.
- MAGNETIC ROTOR:** The central rotating part of the motor, shown as a cylinder.
- COMMUTATION ENCODER:** A sensor that provides feedback to the COMMUTATION LOGIC. It is mechanically coupled to the MAGNETIC ROTOR.
- VELOCITY ENCODER:** A sensor that provides feedback to the CONTROL ENCODER LOGIC. It is mechanically coupled to the COMMUTATION ENCODER.
- PWM CONTROL LOGIC:** Receives feedback from the INPUT BUFFER LOGIC and the CONTROL ENCODER LOGIC. It generates PWM signals for the POWER SWITCHING STAGE.
- COMMUTATION LOGIC:** Receives feedback from the COMMUTATION ENCODER and the CONTROL ENCODER LOGIC. It provides commutation signals to the POWER SWITCHING STAGE.
- CONTROL ENCODER LOGIC:** Receives feedback from the VELOCITY ENCODER and provides a reference signal to the INPUT BUFFER LOGIC.
- INPUT BUFFER LOGIC:** Receives the reference signal from the CONTROL ENCODER LOGIC and provides feedback to the PWM CONTROL LOGIC.

A constant-power brushless DC motor is provided, including a stator which is wound in parallel by phases and polarities and configured of n multi-phases, a rotor having a predetermined number of polarities, which is required to concentrate magnetic flux on its area, a commutation encoder including sensing regions and nonsensing regions, and two photo sensors set to each phase, the two photo sensors being connected to a controller, to excite only $(n-b)$ phases among n phases, starting and rotating the motor, thereby realizing a constant-power DC motor without commutator, which is effective in energy saving, has good characteristic of continuous speed conversion and compact configuration.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

CONSTANT-POWER BRUSHLESS DC MOTOR

TECHNICAL FIELD

The present invention relates to a new motor system,
5 and in particular, to a constant-power brushless DC motor,
which is effective in energy saving, has good
characteristic of speed conversion from a low speed to a
high speed, has no torque ripple, produces high power with
a low voltage, has excellent stable speed characteristic
10 and high efficiency, has compact configuration not to
require a cooling system, and is able to be fabricated in
full automation with low production cost.

BACKGROUND ART

15 A conventional DC motor has problems that its brush
and commutator are worn with the lapse of time, its
configuration is complicated, and requires a high
production cost. Especially, it is difficult to obtain a
high speed of above 6000rpm using a conventional power
20 motor. With an AC inverter motor, its start torque is weak,
controller needs high cost, and constant-power cannot be
produced. Furthermore, a reluctance motor is inferior to
other motors in terms of fabrication cost, size and weight,
and does not produce constant-power. In general, a
25 brushless DC motor is widely used as a small-sized motor.
However, it is difficult to fabricate the surface of
permanent on which a rotor is set, its controller carries
out four-quadrant control, requiring high cost, and
constant-power cannot be produced. Moreover, the brushless
30 DC motor cannot completely solve problems of nonuniform
rotation, torque ripple and heat generation.

DISCLOSURE OF INVENTION

Accordingly, the present invention is directed to a constant-power brushless DC motor that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

5 An object of the present invention is to provide a constant-power brushless DC motor, which has no torque ripple, produces high power with a low voltage, has excellent stable speed characteristic and high efficiency, has compact configuration not to require a cooling system,
10 and is able to be fabricated in full automation with low production cost.

To accomplish the object of the present invention, there is provided a constant-power brushless DC motor, including: a stator which is wound in parallel by phases
15 and polarities and configured of n multi-phases, each of the winding coils of the stator which are not connected with one another is connected to each of n full H-bridges, n full H-bridges are connected to a DC power supply in parallel; a rotor having a predetermined number of
20 polarities, which is required to concentrate magnetic flux on its area; a commutation encoder including sensing regions and nonsensing regions, the commutation encoder being externally set to one side of the shaft of the rotor; and two photo sensors set to each phase, the two photo
25 sensors being connected to half H-bridge of each phase, to turn on/off the half H-bridge, the distance between the sensing regions of the commutator encoder is determined to allow a phases among n phases to be excited all the time, the a photo sensors recognizing the a phases excited.

30 It is preferable that the stator has narrow slots to remove cancel phenomenon. The number of phase among the n phases, which will be excited, is determined by the distance between the sensing regions, the distance between the sensing regions being determined through the following

expression,

distance between sensing regions

= $(2\pi \times \text{number of phases to be excited}) / (\text{number of polarities of rotor} \times \text{number of phases of motor}) (^{\circ})$

5 the number of sensing regions in the commutation encoder being determined through the following expression,

number of sensing regions

= $(\text{number of polarities of rotor}) / 2$

10 the distance between the photo sensors on a sensor plate being determined by the following expression,

distance between photo sensors

= $2\pi / (\text{number of polarities of rotor} \times \text{number of phases of motor}) (^{\circ})$

among the n phases, a phases being excited but b
15 phases not being excited all the time. It is preferable that $b \geq 1$, b corresponding to the number of phases inexcited.

The constant-power brushless DC motor of the present invention, which has multi-phases of 2, 3, 4, 5, 6, ..., n
20 phases, is configured of 1, 2, 3, 4, 5,, a phases excited and 1, 2, 3, 4, 5, ..., b phases inexcited, to alternate the excited phases and inexcited phases, being started and rotated. The rotor is configured of a permanent magnet, the stator is configured of independent winding in
25 multi-phases, and the commutation encoder is externally fixed to one side of the shaft of the rotor to be rotated. The n phases include 2n sensors which are connected to the switching stage to sense the location of the rotor, indicating the direction and interval of current, thereby
30 starting and rotating the motor. The stator, rotor, sensors and controller are constructed to be automatically fabricated, reducing the manufacture cost.

It is to be understood that both the foregoing general description and the following detailed description are

exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention:

In the drawings:

Fig. 1 is a block diagram of a constant-power brushless DC motor according to the present invention;

15 Fig. 2A illustrates the back of photo sensor of the constant-power brushless DC motor according to the present invention;

Fig. 2B is a cross-sectional view of the sensor of Fig. 2A;

20 Fig. 3A illustrates cancel eliminated slots for removing the cancel phenomenon of magnetic flux of armature;

Fig. 3B illustrates stator winding of 5-phase 6-polarity motor;

25 Fig. 4A illustrates 6-polarity inner rotor with bar permanent magnet inserted in laminated silicon (steel) plate;

Fig. 4B illustrates 16-polarity outer rotor with bar permanent magnet inserted out of laminated silicon (steel) plate;

30 Fig. 4C illustrates slip ring of 6-polarity electro-magnet rotor;

Fig. 5A illustrates driving circuit of 5-phase motor;

Fig. 5B illustrates that the commutation encoder and

photo sensors of 5-phase 6-polarity motor are set on the rotor;

Fig. 6 illustrates torque generated when three phases are excited in 5-phase 6-polarity motor;

5 Fig. 7A illustrates that the distance corresponding to three phases is advanced-commutated in 8-phase 6-polarity motor;

Fig. 7B illustrates that the distance corresponding to five phases is advanced-commutated in 8-phase 6-polarity
10 motor; and

Fig. 8 illustrates constant-power characteristic of the constant-power brushless DC motor according to the present invention.

15 **BEST MODE FOR CARRYING OUT THE INVENTION**

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

The configuration of the constant-power brushless DC
20 motor according to the present invention is explained below. Its stator, configured of n phases, is connected to the electronic commutator in parallel, each phase being independently wound. The rotor configured of a permanent magnet has a predetermined number of polarities of 2, 4, 6,
25 8, ... to meet the design of the stator. The commutation encoder has a cylindrical shape constructed in such a manner that a ring-shape plate is mounted on the edge of a round-shape plate. The encoder includes a sensing region sensed by a photo sensor and nonsensing region, the sensing
30 region being formed by cutting the ring-shape plate to excite $(n-b)$ phases. That is, the sensing region allows a phases among the n phases to be excited all the time.

With the photo sensor, each phase has two photo

sensors which operate in accordance with the commutation encoder. One photo sensor and the other photo sensor of one phase are placed in the angle of space between polarities of the rotor, being separated from each other. The photo
5 sensors of each phase are sequentially arranged on the angle of space between phases. With the electronic commutator, each coil having multi-phases is connected to a predetermined number of full H-bridge, corresponding to the number of phases, and each of the two photo sensors of
10 each phase is connected to a half H-bridge. The electronic commutator and each H-bridge are connected to power supply in parallel. According to the aforementioned configuration, the present invention accomplishes the constant-power brushless DC motor having continuous speed conversion and
15 uniform efficiency.

Fig. 1 is a block diagram of the constant-power brushless DC motor according to the present invention, which shows 5-phase stator, rotor, commutation encoder and control encoder which construct the rotor (stator and
20 rotor), controller and power supply system. For open loop operation, the motor is controlled by only pulse width modulation control without employing the control encoder or control encoder logic. For closed loop operation, the control encoder, control encoder logic and input buffer
25 logic are compared with the pulse width modulation control logic, performing speed control or location control with pulse width modulation. The motor is controlled by only pulse width modulation without using variable frequency control or vector control, resulting in easy control of
30 motor and simple circuit configuration.

Figs. 2A and 2B illustrate the sensor of 5-phase 6-polarity motor. The commutation encoder and control encoder are externally fixed on one side of the shaft of the rotor placed outside the bracket on the back of the rotor, being

rotated with the rotor. The sensor board on which the photo sensors are placed is set on the circumference of the bracket. The sensor board is adjusted to be set to allow advanced commutation. The control encoder is constructed in a manner that openings(or slots) are formed in desired portions of the ring-shape plate to allow the photo sensor to emit pulses, as shown in Fig. 1 and 2A. Here, the size of the trenches and partition angle between them depend on the characteristics of speed control or location control of the motor.

Fig. 3A illustrates the wrought silicon (steel) plate (or laminated plate) of 5-phase 6-polarity typed stator, constructed in such a manner that narrow slots are formed between winding slots. Fig. 3B illustrates the winding of the 5-phase 6-polarity stator. Each of five phases is independently wound in parallel, being wound in parallel for each polarity, constructing the stator. Fig. 4A illustrates a 6-polarity permanent magnet rotor. Referring to Fig. 4A, a bar type permanent magnet is inserted into laminated silicon (steel) plate which is combined with the dove tail type holder of non-magnetic hub, constructing the rotor. Fig. 4B illustrates the external rotor pan-cake type permanent magnet rotor, and Fig. 4C illustrates a slip ring type electro-magnet rotor.

Figs. 5A and 5B illustrate the electronic commutator circuit of 5-phase 6-polarity motor. In configuration of the commutation encoder, the number of sensing regions, that is, light emission recognition parts, is determined according to the following expression.

The number of sensing regions
= the number of polarities of rotor/2

Accordingly, the number of sensing regions in the 5-phase 6-polarity motor shown in Fig. 5 corresponds to 3. The width (angle of shaft) of sensing region is determined

by the following expression.

The width of sensing region
= $\{2\pi/(\text{number of polarities} \times \text{number of phases})\} \times$
number of phases to be excited ($^{\circ}$)

5 Accordingly, with the 5-phase 6-polarity motor shown
in Fig. 5, only three phases are excited to make the angle
of shaft of sensing region 36° . Referring to Figs. 5A and
5B, PA_1 connected to Q1 and Q4 of half bridge whose one
phase is excited and PA_2 connected to Q2 and Q3 of another
10 half bridge whose one phase is excited are located at the
same position of different polarities. Thus, when the
circuit is electrified, PA_1 of one phase is located in the
sensing region to emit positive pulse, turning on half
bridge Q1 and Q4 of Fig. 5A. This make the coil
15 electrifying, and the coil looped by Q1 and Q4 is excited.
While the rotor rotates, turning-on interval of half bridge
Q1 and Q4 is identical to the width of the sensing region
of the commutation encoder. That is, excitation interval of
half bridge Q1 and Q4 corresponds to shaft angle of 36° .

20 When the shaft angle is next 24° ($60^{\circ} - 36^{\circ}$), PA_1 and
 PA_2 are placed in nonsensing region, turning off Q1, Q4, Q2
and Q3 of one-phase half bridge. Then, PA_2 like as PA_1 turn
on Q2 and Q3 according to rotation of the commutation
encoder, to allow one phase to independently become
25 electrified, starting the rotor. The photo sensors are set
on the sensor plate of Fig. 5B, having interval of
 $2\pi/(\text{number of polarities} \times \text{number of phases}) (^{\circ})$. In Fig. 5B,
for example, ten photo sensors are arranged, having the
interval of 12° . The interval between two photo sensors of
30 each phase corresponds to $2\pi/(\text{number of polarities of}$
rotor). Thus, the distance between PA_1 and PA_2 is 60° .

As shown in Figs. 5A and 5B, three phases are excited
but two phases are inexcited all the time in 5-phase 6-
polarity motor. Accordingly, excitation interval and

inexcitation interval of each phase are determined by the following expressions.

Excitation angle

$$= \pi \times (\text{number of excited phases}) / (\text{number of phases}) (^{\circ})$$

5 Inexcitation angle

$$= \pi \times (\text{number of inexcited phases}) / (\text{number of phases}) (^{\circ})$$

Thus, the excitation angle and inexcitation angle of each phase of Fig. 5 are 108° and 72° , respectively.

Fig. 6 shows pulse output of each photo sensor, direction of current input and delineation and interval of torque of 5-phase 6-polarity motor. The coil becomes electrified with current having the interval identical to the pulse transmitted by each photo sensor depending on the distance between the sensing regions of the commutation encoder, resulting in generation of torque. Thus, square and partial current wave is inputted and power of scheme of rectangular torque is outputted. Accordingly, three phases are excited and two phases are inexcited all the time in 5-phase 6-polarity motor shown in Fig. 5. Consequently, the sum total of torque corresponds to linear torque scheme.

As shown in Figs. 5 and 6, the number of phases of the motor, which will be excited, depends on the distance between the sensing regions of the commutation encoder. The motor of the present invention solves all problems which occur in pole changing area. Specifically, the motor of the present invention is constructed in a manner that more than one of multi-phases are not excited to produce advanced commutation, resulting in smooth high-speed rotation.

In the process of converting electric energy into mechanical energy by the motor, timing that the stator coil is electrified to be excited to allow active magnetic flux to generate magnetic motive force is delayed from timing that passive magnetic flux of rotor which rotates in high speed is operated. Accordingly, advanced commutation is

required to make the timings coincide with each other. Fig. 7A illustrates 8-phase 6-polarity motor in which only five phases are excited and the distance corresponding to three phases inexcited is advanced-commutated. Fig. 7B illustrates 8-phase 6-polarity motor in which three phases are excited and the distance corresponding to five phases inexcited is advanced-commutated. The motor of Fig. 7A can be rotated faster than the motor of Fig. 7B.

Furthermore, in construction of very high-speed motor, the commutation encoder logic performs electronic combination changing for each photo sensor together with advanced photo sensor depending on microprocessor, performing gradual advanced commutation to meet a desired speed.

Fig. 8 illustrates the relationship between torque and speed of the constant-power brushless DC motor. As shown in Fig. 8, the DC motor of the present invention has constant-power characteristic. Furthermore, the DC motor of the present invention has CW and CCW capability and bidirectional operation. That is, when the commutation encoder logic in Figs. 1 and 5 performs electronic combination changing for dual photo sensors included in each phase, the motor smoothly starts and rotates from forward direction to reverse direction or from reverse direction to forward direction. When electronic combination changing of photo sensor is carried out frequently within 5/1000sec, bidirectional operation is easily activated. The DC motor of the present invention also has linear motor function. Specifically, ideal linear motor can be realized when the stator of motor is configured of linear type and its rotor is constructed to operate linearly.

According to the present invention, narrow slot of the stator removes collision of magnetic flux which is generated when the coil of each phase is electrified,

improving the efficiency of the motor. There is no current loss and uniform electrification is carried out when the coil is in electrified, resulting in motor without torque ripple and controller with stability. Furthermore, the stator is parallel-wound by phases and polarities to allow the motor to produce a high power with a low voltage. The stator's parallel winding enables automatic production of motor, reducing the cost and making mass production possible.

Moreover, since magnetic flux is concentrated on the rotor area, passive magnetic flux of the rotor corresponds to active magnetic flux of the stator, realizing high-power motor using permanent magnet rotor. The surface of the rotor is machined to minimize empty space, improving the efficiency of the motor. Because there is no limitation in the number of polarity, size, shape of the rotor, long drum type or pan-cake type motor can be designed unrestrictedly for purposes. The rotor is assembled into the motor to allow automatic production, reducing the cost and enabling mass production.

Meanwhile, in commutation motors, motors using full sine wave or full square wave generate brake torque, back electromotive force(EMF), reactance (inductive reactance and capacitive reactance) and harmonic wave in pole changing area, so as to bring about iron loss and copper loss in the motor, impacting the controller. Furthermore, heat generates in the motor, to require cooling system and deteriorate its efficiency. However, the motor of the present invention does not apply current to the phase which is placed in pole changing area, to solve the above problems, eliminating necessity of cooling system and improving the efficiency of motor.

Moreover, partial square wave maximizes rms torque capacitance and peak torque value. Thus, the motor becomes

compact and its efficiency is improved. Furthermore, The controller does not require cross fire prevention device, to simplify its circuit with stability, improving reliability and reducing the cost. The magnetic flux densities and permeability of the stator and rotor are identical because they are configured of the same material, silicon steel plate. Thus, characteristic of relation between current and torque is perfect, and characteristic of relation between current and speed is also excellent. This allows the motor to produce constant-power, resulting in uniform efficiency for all speed ranges.

The torque of conventional motor is sinusoidal torque scheme or trapezoidal torque scheme, causing torque ripple. The motor of the present invention applies partial square wave to the winding coil of each phase, to allow each phase to realize rectangular torque scheme, the total torque becoming linear torque scheme. Accordingly, the motor according to the present invention has no torque ripple and smoothly starts and rotates. Furthermore, with the constant-power brushless DC motor of the present invention, while b phases among n phases are inexcited, advanced commutation is performed for the distance corresponding to the b phases inexcited. Therefore, the present invention realizes the constant-power motor having continuous speed conversion and uniform efficiency. The motor carries out electronic neutral commutation according to the microprocessor, to perform smooth CW-CCW control, bidirectional control with high speed, and smooth position control.

It will be apparent to those skilled in the art that various modifications and variations can be made in the constant-power brushless DC motor of the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention

cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

WHAT IS CLAIMED IS:

1. A constant-power brushless DC motor, comprising:
a stator which is wound in parallel by phases and polarities and configured of n multi-phases, each of the
5 winding coils of the stator which are not connected with one another is connected to each of n full H-bridges, n full H-bridges are connected to a DC power supply in parallel;
a rotor having a predetermined number of polarities,
10 which is required to concentrate magnetic flux on excitation area;
a commutation encoder including sensing regions and nonsensing regions, the commutation encoder being externally set to one side of the shaft of the rotor; and
15 two photo sensors set to each phase, the two photo sensors being connected to half H-bridge of each phase, to turn on/off the half H-bridge, the distance between the sensing regions of the commutator encoder is determined to allow a phases among n phases to be excited all the time,
20 the a photo sensors recognizing the a phases excited.
2. The motor as claimed in claim 1, wherein the stator has narrow slots to remove cancel phenomenon.
- 25 3. The motor as claimed in claim 3, wherein the number of phase among the n phases, which will be excited, is determined by the distance between the sensing regions, the distance between the sensing regions being determined through the following expression,
30 distance between sensing regions
= $(2\pi \times \text{number of phases to be excited}) / (\text{number of polarities of rotor} \times \text{number of phases of motor}) (^{\circ})$
the number of sensing regions in the commutation

encoder being determined through the following expression,
number of sensing regions
= (number of polarities of rotor)/2
the distance between the photo sensors on a sensor
5 plate being determined by the following expression,
distance between photo sensors
= $2\pi / (\text{number of polarities of rotor} \times \text{number of phases of motor})$ ($^{\circ}$)
among the n phases, a phases being excited but b
10 phases not being excited all the time.

4. The motor as claimed in claim 3, wherein $b \geq 1$, b corresponding to the number of phases inexcited.

FIG.1

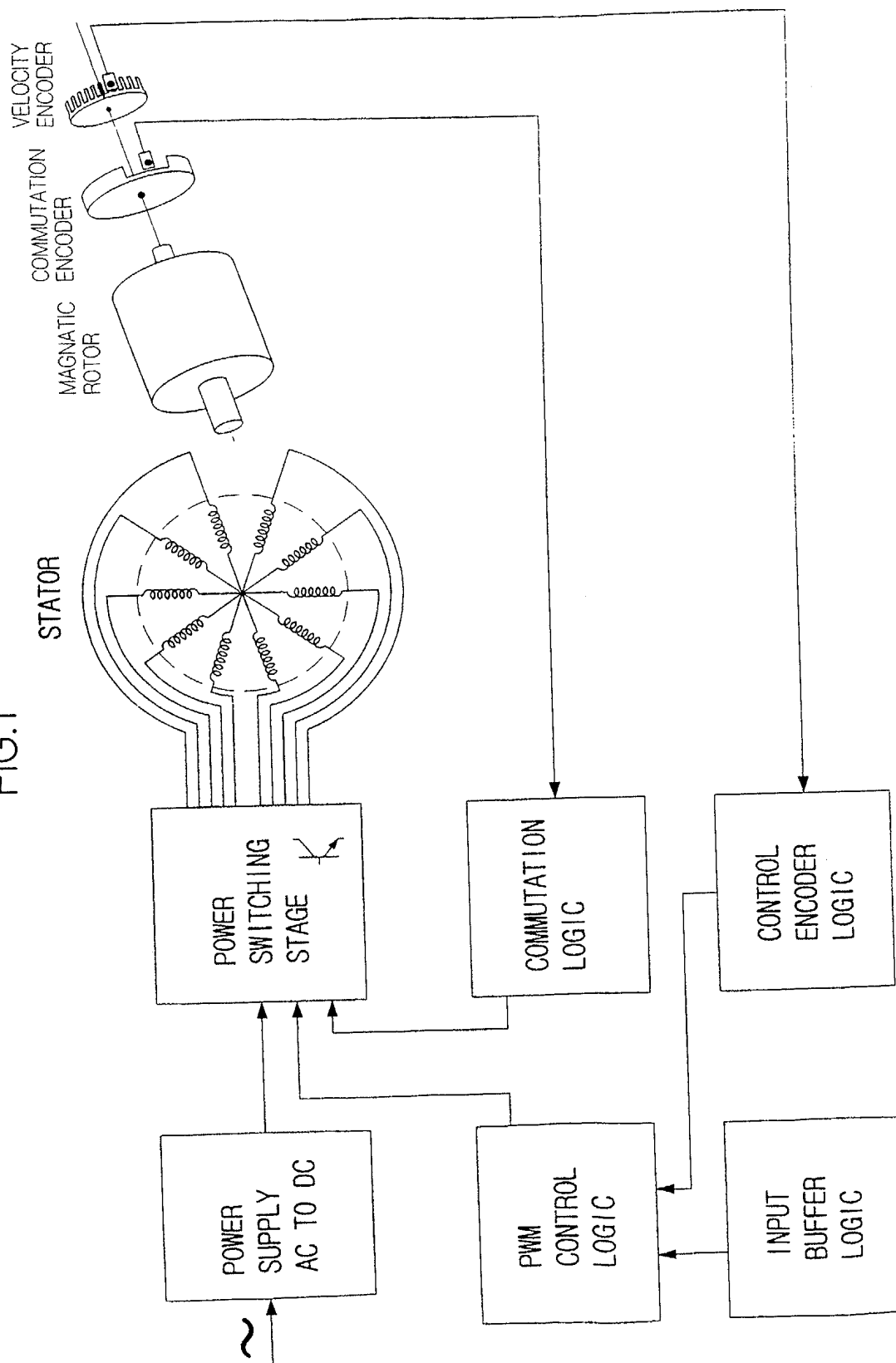


FIG.2A

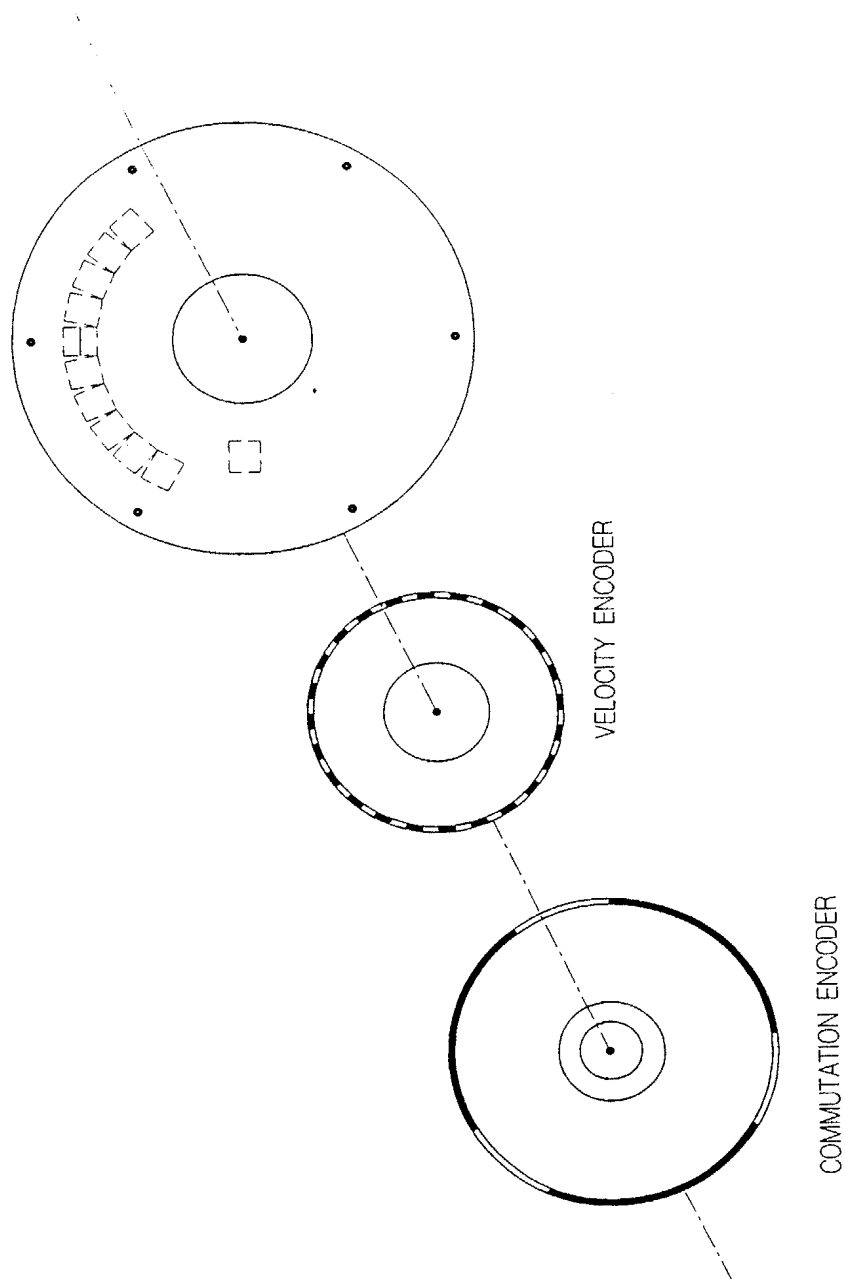


FIG.2B

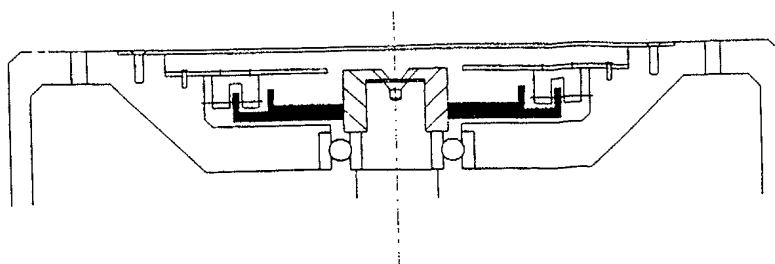


FIG.3A

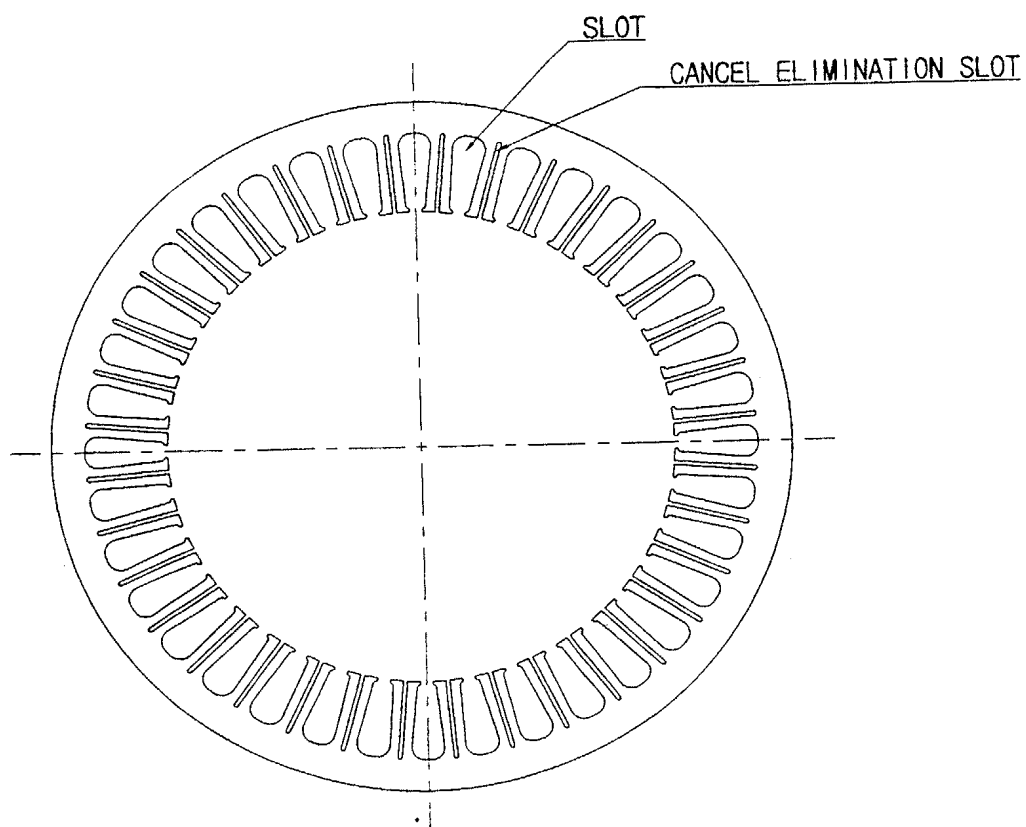


FIG.3B

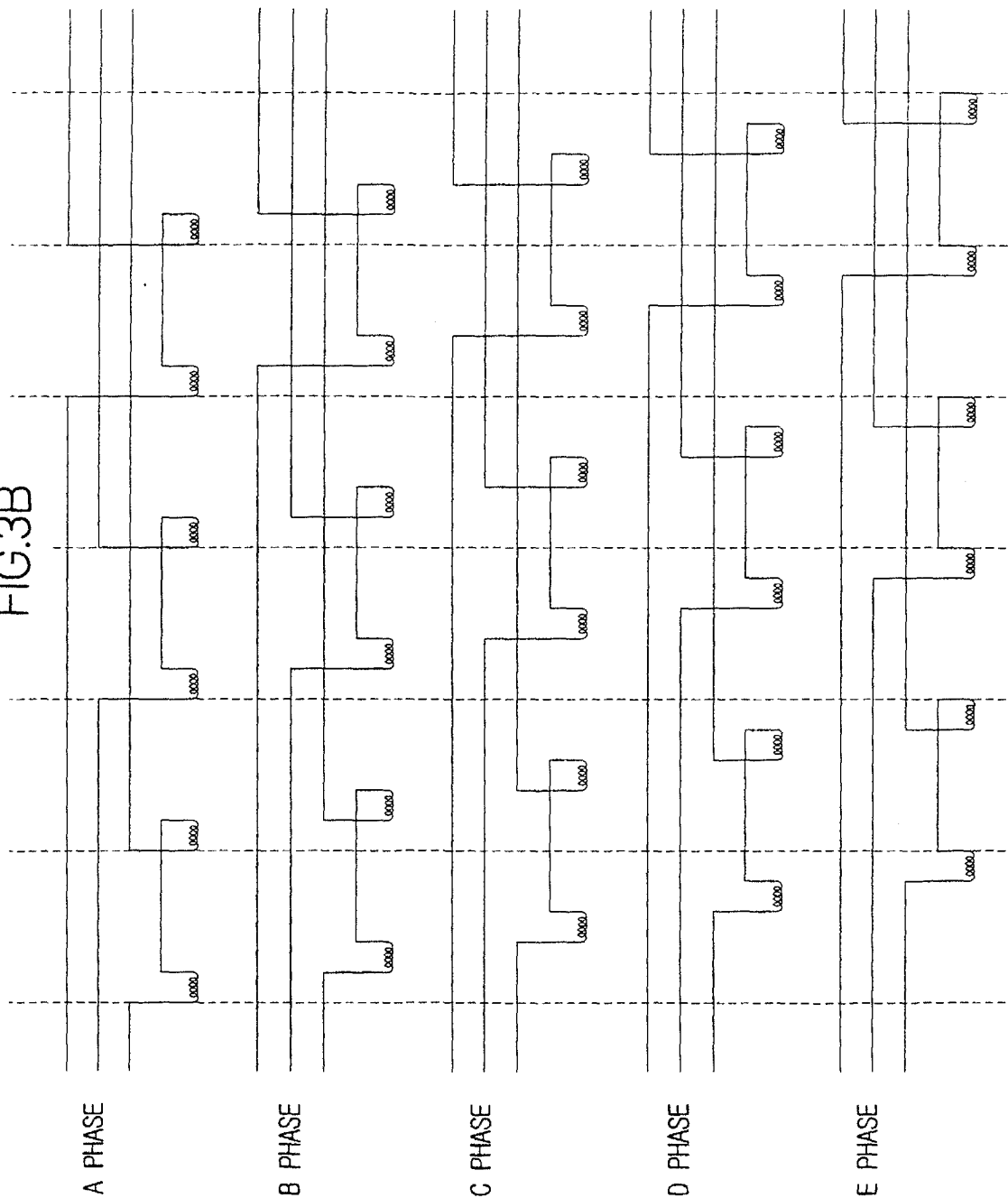


FIG.4B

OUTER ROTOR

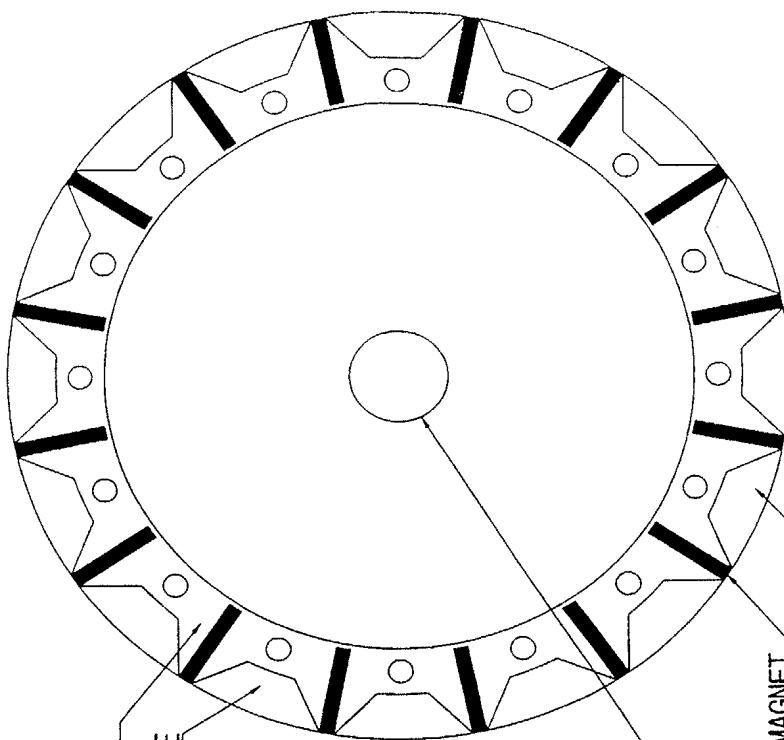
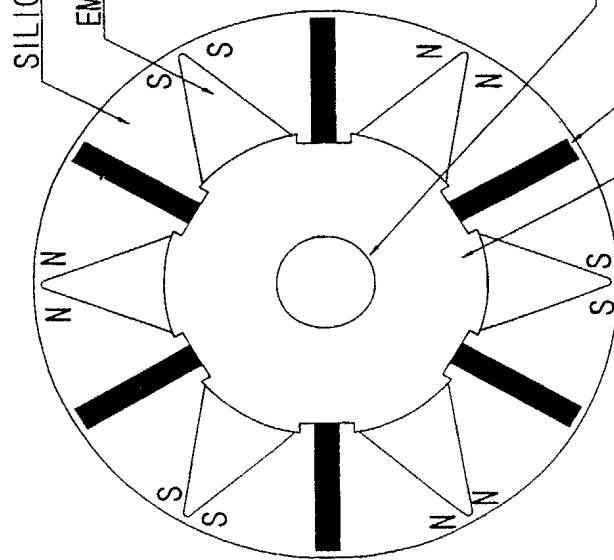


FIG.4A

INNER ROTOR



SILICON STEEL

EMPTY SPACE

SHAFT

PERMANENT MAGNET

NONMAGNETIC METAL

FIG.4C

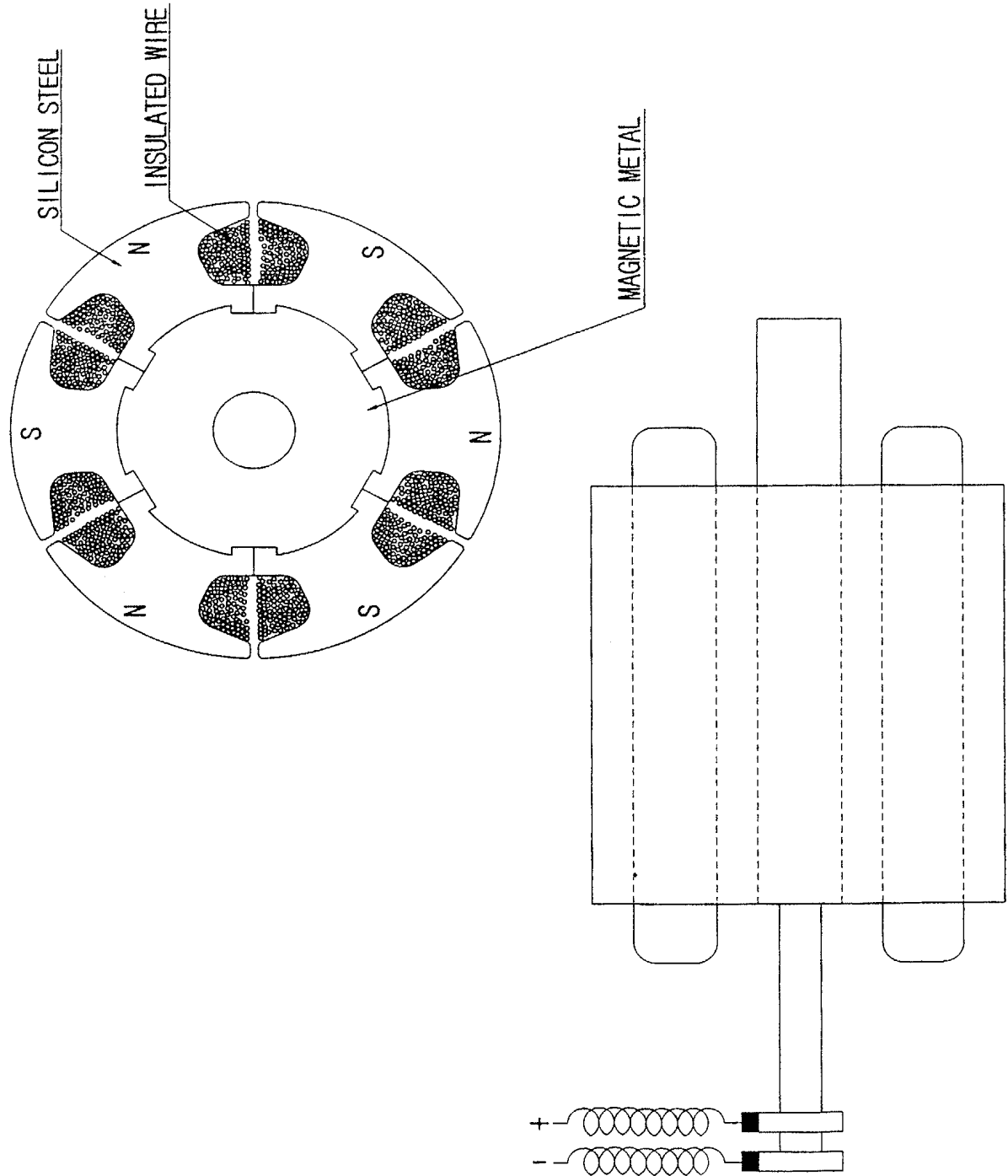


FIG.5B

FIG.5A

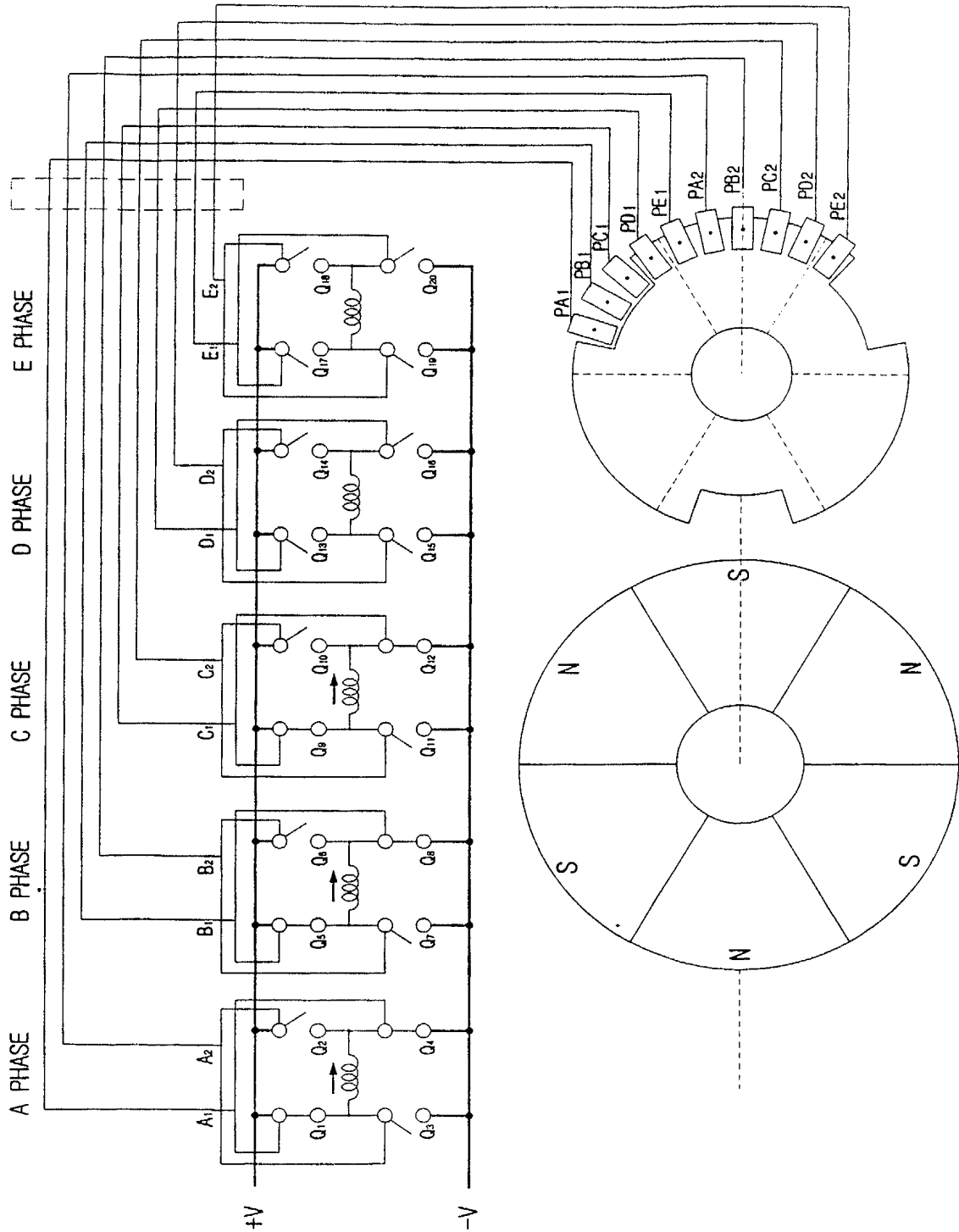


FIG.6

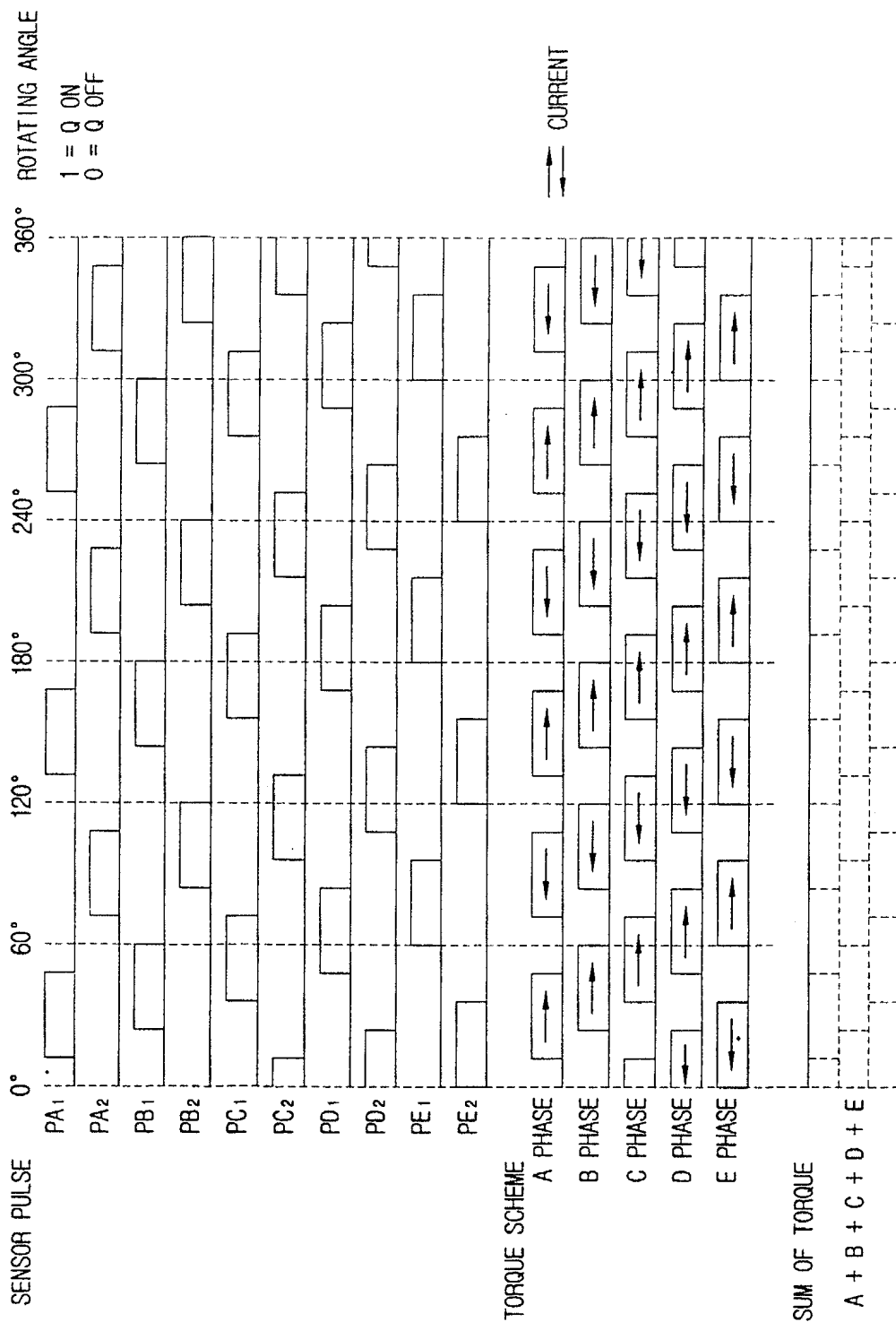


FIG.7A

(8-3)PHASE EXCITING

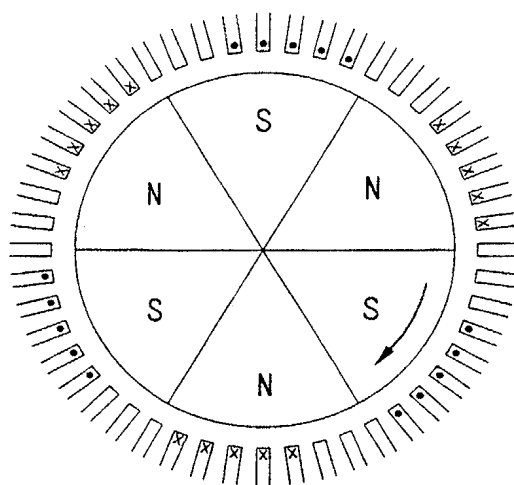


FIG.7B

(8-5)PHASE EXCITING

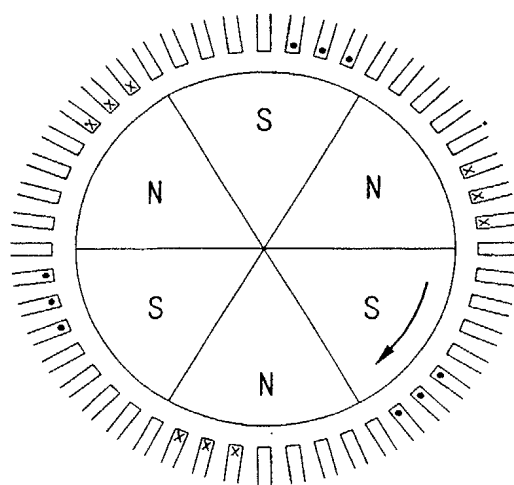
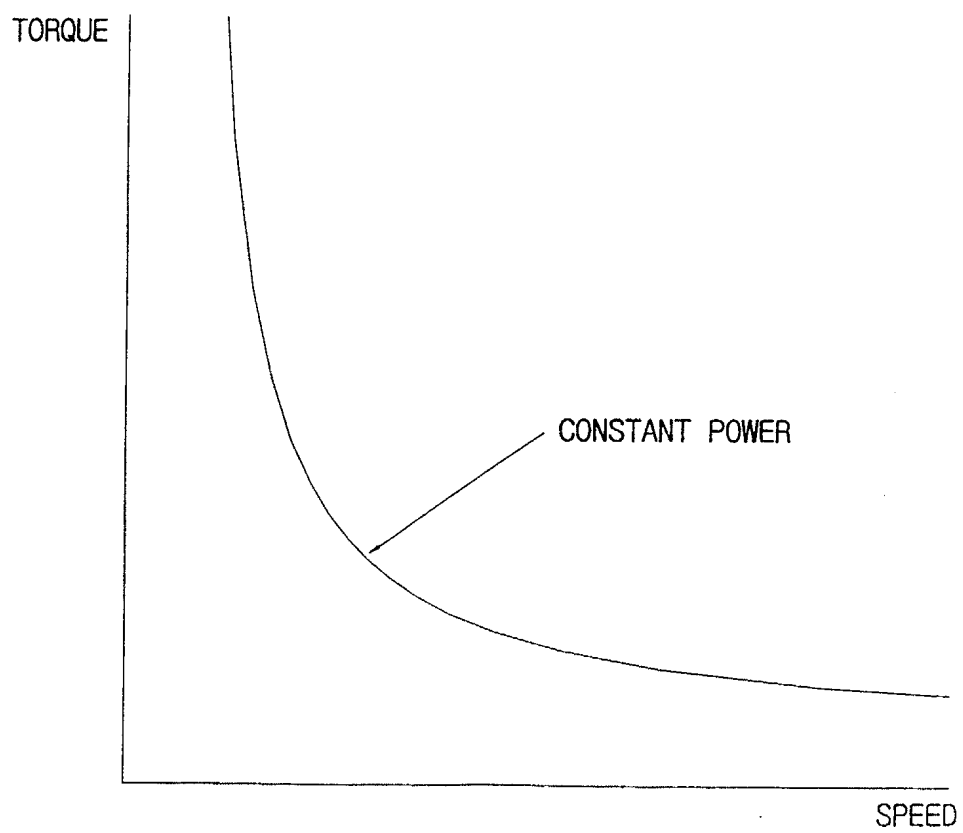


FIG.8



PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference PIS115/PCT	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/KR 99/00069	International filing date (<i>day/month/year</i>) 09 February 1999 (09.02.99)	(Earliest) Priority Date (<i>day/month/year</i>) 11 February 1998 (11.02.98)
Applicant I.S. MOTOR KOREA CO., LTD. et al.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (See Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.: 1

☒ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 99/00069

A. CLASSIFICATION OF SUBJECT MATTER IPC ⁷ : H 02 K 29/00 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC ⁷ : H 02 K, H 02 P Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPI, EPODOC		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4882524 A (LEE) 21 November 1989 (21.11.89), column 1, line 53 - column 2, line 19; claims.	1,3,4
Y	US 4484115 A (TAKAHASHI) 20 November 1984 (20.11.84), column 4, line 48 - column 5, line 37; fig. 8-10.	1,3,4
A	US 5327069 A (RADUN et al.) 05 July 1994 (05.07.94), abstract; fig. 5,8.	1
A	DE 2101937 A (TOKYO SHIBAURA) 29 July 1971 (29.07.71), claims 1,6,7; fig. 6A,7,8.	1

<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
<div style="display: flex; justify-content: space-between;"> <div style="width: 48%;"> <p>* Special categories of cited documents:</p> <p>„A“ document defining the general state of the art which is not considered to be of particular relevance</p> <p>„E“ earlier application or patent but published on or after the international filing date</p> <p>„L“ document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>„O“ document referring to an oral disclosure, use, exhibition or other means</p> <p>„P“ document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 48%;"> <p>„T“ later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>„X“ document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>„Y“ document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>„&“ document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search <div style="text-align: center; font-weight: bold;">02 May 2000 (02.05.00)</div>		Date of mailing of the international search report <div style="text-align: center; font-weight: bold;">10 May 2000 (10.05.00)</div>
Name and mailing address of the ISA/AT Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/200		Authorized officer <div style="text-align: center; font-weight: bold;">Dimitrow</div> Telephone No. 1/53424/340

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR 99/00069

Patent document cited in search report				Publication date	Patent family member(s)			Publication date
US	A	4882524		21-11-1989	AU	A1	14472/88	27-10-1988
					AU	B2	616365	24-10-1991
					BE	AD	1004032	15-09-1992
					CH	A	682193	30-07-1993
					DE	A1	3812638	10-11-1988
					DE	C2	3812638	14-06-1995
					ES	AF	2007816	01-07-1989
					FR	A1	2614480	28-10-1988
					GB	A0	8808555	11-05-1988
					GB	A1	2204197	02-11-1988
					GB	B2	2204197	08-05-1991
					HK	A	832/92	06-11-1992
					IT	A0	8847880	21-04-1988
					IT	A	1219549	18-05-1990
					KR	B1	8904099	20-10-1989
					SG	A	432/92	12-06-1992
					JP	A2	58012566	24-01-1983
US	A	4484115		20-11-1984	none			
US	A	5327069		05-07-1994	none			
DE	B2	2101937		22-09-1977	GB	A	1293291	18-10-1972
DE	C3	2101937		18-05-1978	JP	B4	51028128	17-08-1976
DE	A	2101937		29-07-1971	JP	B4	51028127	17-08-1976
					JP	B4	49041962	12-11-1974
					JP	B4	52018363	21-05-1977

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To:

GAM, DONG HOON
GAM DONG HOON INT'L PATENT & LAW
OFFICE
NO.207, NEW SEOUL BLDG., 828-8
YEOKSAM-DONG, KANGNAM-GU
SEOUL 135-080
REPUBLIC OF KOREA

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing
(day/month/year) 10 Mai. 2000 (10.05.00)

Applicant's or agent's file reference

PIS115/PCT

FOR FURTHER ACTION See paragraphs 1 and 4 below

International application No.

PCT / KR 99/00069

International filing date
(day/month/year)

9 Feb. 1999 (09.02.99)

Applicant

I. S. MOTOR KOREA CO., LTD. et al.

1. ☒ The applicant is hereby notified that the international search report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the ISA/ AT
AUSTRIAN PATENT OFFICE
Kohlmarkt 8-10
A-1014 Vienna
Facsimile No. +43 / 1 / 534 24 - 200

Authorized officer
Koch
+43 / 1 / 534 24 - 450
Telephone No.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PIS115/PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No PCT/KR 99/00069	International filing date (day/month/year) 09 February 1999 (09.02.99)	Priority Date (day/month/year) 11 February 1998 (11.02.98)
International Patent Classification (IPC) or national classification and IPC IPC⁷: H 02 K 29/00		
Applicant I.S. MOTOR KOREA CO., LTD et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examination Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of <u>3</u> sheets, including this cover sheet. <input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of _____ sheets.
3. This report contains indications relating to the following items: I <input type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 02 August 1999 (02.08.99)	Date of completion of this report 05 May 2000 (05.05.00)
Name and mailing address of the IPEA/AT Austrian Patent Office Kohlmarkt 8-10 A-1014 Vienna Facsimile No. 1/53424/200	Authorized officer Dimitrow Telephone No. 1/53424/340

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/KR 99/00069

I. Basis of the report

1 With regard to the elements of the international application:*

☒ the international application as originally filed☐ the description

pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

☐ the claims

pages _____, as originally filed
 pages _____, as amended (together with any statement) under Article 19
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

☐ the drawings

pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

☐ the sequence listing part of the description:

pages _____, as originally filed
 pages _____, filed with the demand
 pages _____, filed with the letter of _____

2 With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item. These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3 With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4 ☐ The amendment have resulted in the cancellation of:☐ the description, pages _____☐ the claims, Nos. _____☐ the drawings, sheets/fig. _____5 ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "replacements" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/KR 99/00069

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-4	YES
	Claims		NO
Inventive step (IS)	Claims	2	YES
	Claims	1,3,4	NO
Industrial applicability (IA)	Claims	1-4	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

The following documents were cited in the search report:

D1 US 4882524 A

D2 US 4484115 A

D3 US 5327069 A

D4 DE 2101937 A

Document D1 shows a multi-phase bipolar brushless D.C. Motor with the features of claim 1. Each phase has a plurality of windings which however are connected in series.

Document D2 shows a brushless D.C. Motor, whose armature windings are connected together at one end and connected to respective commutating devices at the other ends.

In combination of document D1 with document D2 the subject-matter of claims 1,3 and 4 is considered not to include an inventive step. The selection of the type of circuit is a matter of normal design procedure. The skilled person would regard the necessary circuits according to the measures of claim 1, 3 or 4 as a normal design possibility in order to solve the problem posed.

Documents D3 and D4 show the state of the art only.

Industrial applicability is given for all claims.